National Aeronautics and Space Administration

An Evidence Base for Human Spaceflight Risks in Wikipedia

Aerospace Medical Association
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Disclosure Information

I have no financial relationships to disclose.

I will not discuss off-label use and/or investigational use in my presentation

Human Research Program Goal

The goal of HRP is to provide human health and performance

countermeasures,

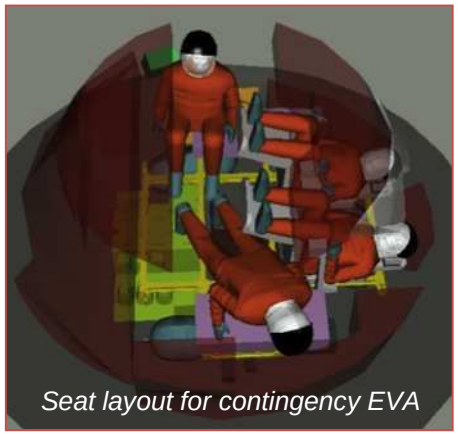
knowledge,

technologies, and

tools

to enable safe, reliable, and productive human space exploration.

Clay Anderson centrifuges Nutrition blood samples during Increment 15



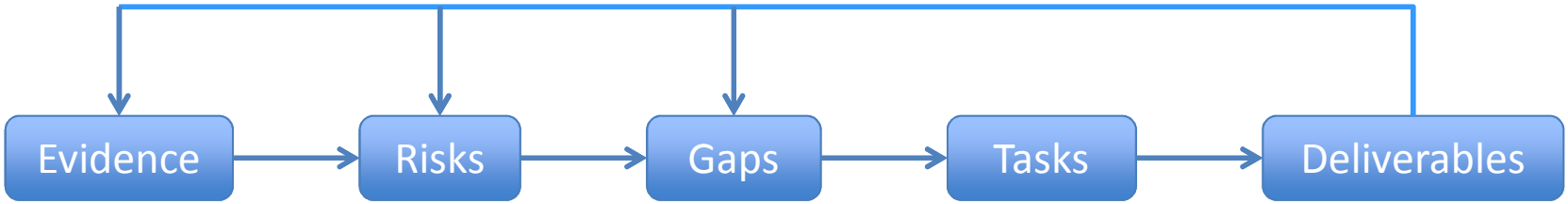
Seat layout for contingency EVA

Example of a study on the effects of center of gravity on performance

HRP Risks

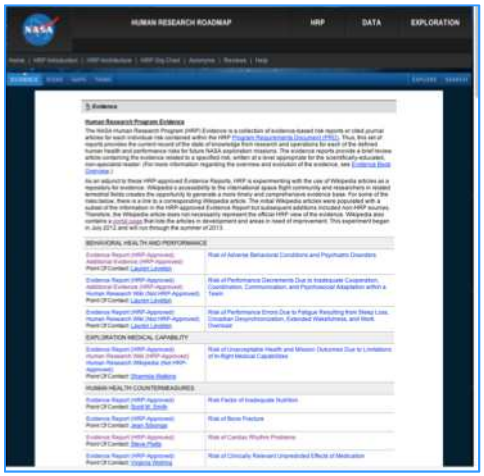
1. Risk Factor of Inadequate Nutrition
2. Risk of Acute and Late Central Nervous System Effects from Radiation Exposure
3. Risk of Acute Radiation Syndromes Due to Solar Particle Events (SPEs)
4. Risk of Adverse Behavioral Conditions and Psychiatric Disorders
5. Risk of Adverse Health Effects Due to Alterations in Host-Microorganism Interactions
6. Risk of Adverse Health Effects of Exposure to Dust and Volatiles During Exploration of Celestial Bodies
7. Risk of an Incompatible Vehicle/Habitat Design
8. Risk of Bone Fracture
9. Risk of Cardiac Rhythm Problems
10. Risk of Clinically Relevant Unpredicted Effects of Medication
11. Risk of Compromised EVA Performance and Crew Health Due to Inadequate EVA Suit Systems
12. Risk of Crew Adverse Health Event Due to Altered Immune Response
13. Risk of Decompression Sickness
14. Risk Of Degenerative Tissue Or Other Health Effects From Radiation Exposure
15. Risk Of Early Onset Osteoporosis Due To Spaceflight
16. Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Space Flight
17. Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance
18. Risk of Inadequate Critical Task Design
19. Risk of Inadequate Design of Human and Automation/Robotic Integration
20. Risk of Inadequate Human-Computer Interaction
21. Risk of Injury from Dynamic Loads
22. Risk of Intervertebral Disk Damage
23. Risk of Orthostatic Intolerance During Re-Exposure to Gravity
24. Risk of Performance Decrement and Crew Illness Due to an Inadequate Food System
25. Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team
26. Risk of Performance Errors Due to Fatigue Resulting from Sleep Loss, Circadian Desynchronization, Extended Wakefulness, and Work Overload
27. Risk of Performance Errors Due to Training Deficiencies
28. Risk of Radiation Carcinogenesis
29. Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity
30. Risk of Renal Stone Formation
31. Risk of Spaceflight-Induced Intracranial Hypertension/Vision Alterations
32. Risk of Unacceptable Health and Mission Outcomes Due to Limitations of In-flight Medical Capabilities

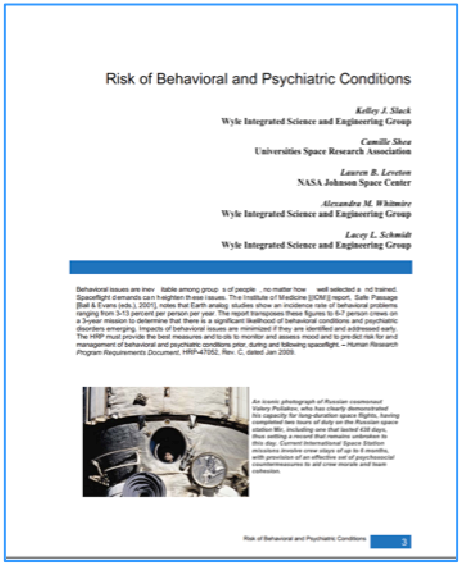
Program Architecture



First Generation Evidence Base

- 2008 Evidence Book
  - One volume
  - One chapter for each HRP risk
  - Review paper format
    - Aimed at scientifically-educated, non-specialist reader
    - Current state of knowledge from both research and operations.
  - Authors
    - Human Research Program
    - National Space Biomedical Research Institute

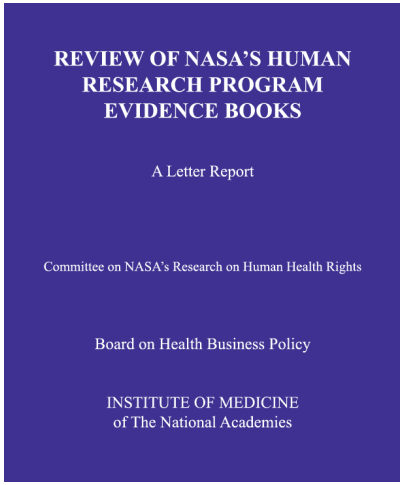




- Chapters linked to their risk on HRP website
  - humanresearchroadmap.nasa.gov/Evidence/

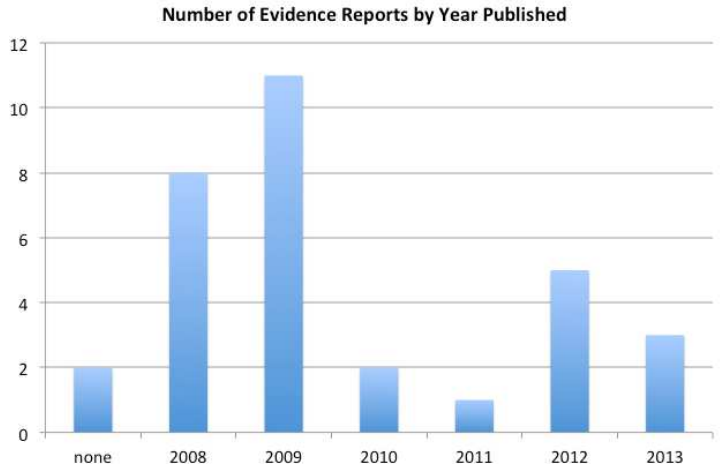
Institute of Medicine Review

- The February 2008 versions of the Evidence-Based Risk Reports were reviewed by members of a committee on NASA's Research on Human Health Risks, established by the Institute of Medicine.
- The resulting thorough *Review of NASA's Human Research Program Evidence Books: A Letter Report (2008)* provided outstanding guidance for both the revision of the current risk reports and for the development of future versions.
  - humanresearchroadmap.nasa.gov/reviews/IOM%20Review.pdf
- This review also offered excellent suggestions to improve public access to the information in these reports.



Limitations of the 1GEB

- Limited authorship
  - NASA and NSBRI
  - Missing ISS international partners
  - Missing researchers studying related terrestrial issues
- Laborious update process
  - Resulting in “all or none” updates
- Infrequent updates

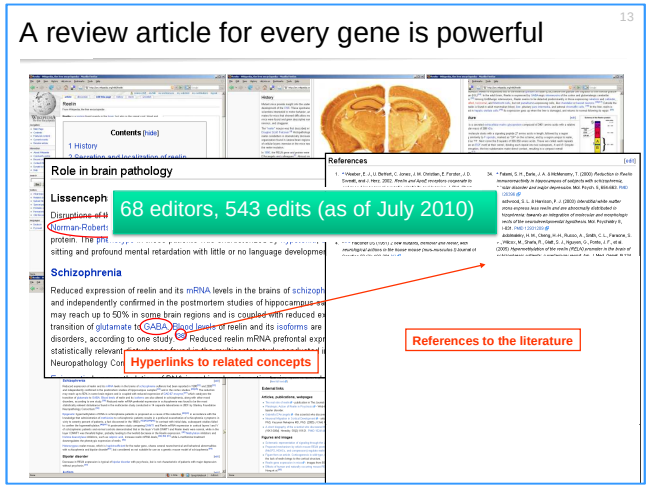


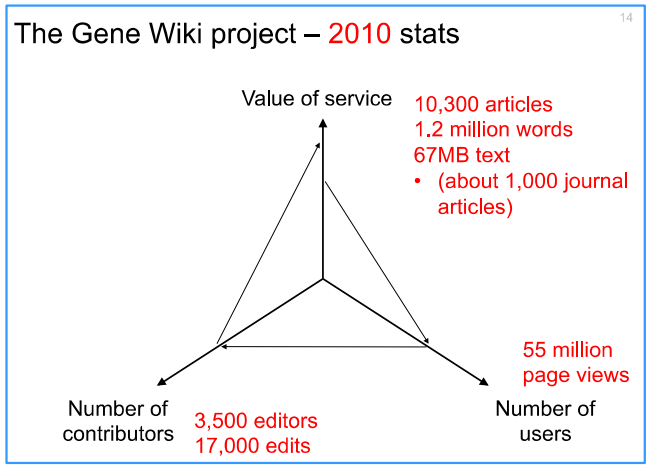
Note: Some Evidence Reports have been supplemented by a bibliography or additional report

The Second Generation Evidence Base- Wikipedia

- The Gene Wiki precedent
  - Enable the creation of a collaboratively written, continuously updated, high quality review article for all (~25,000) human genes.
  - Wikipedia
    - "Stub" articles for each gene in standardized format
    - Users add and refine content
    - en.wikipedia.org/wiki/Gene_Wiki

- The HRP implementation
  - Portal page in Wikipedia
  - Main article for each Risk
    - Subarticles as needed
    - Links to related Wikipedia content
    - Summary of HRP-approved Evidence Report

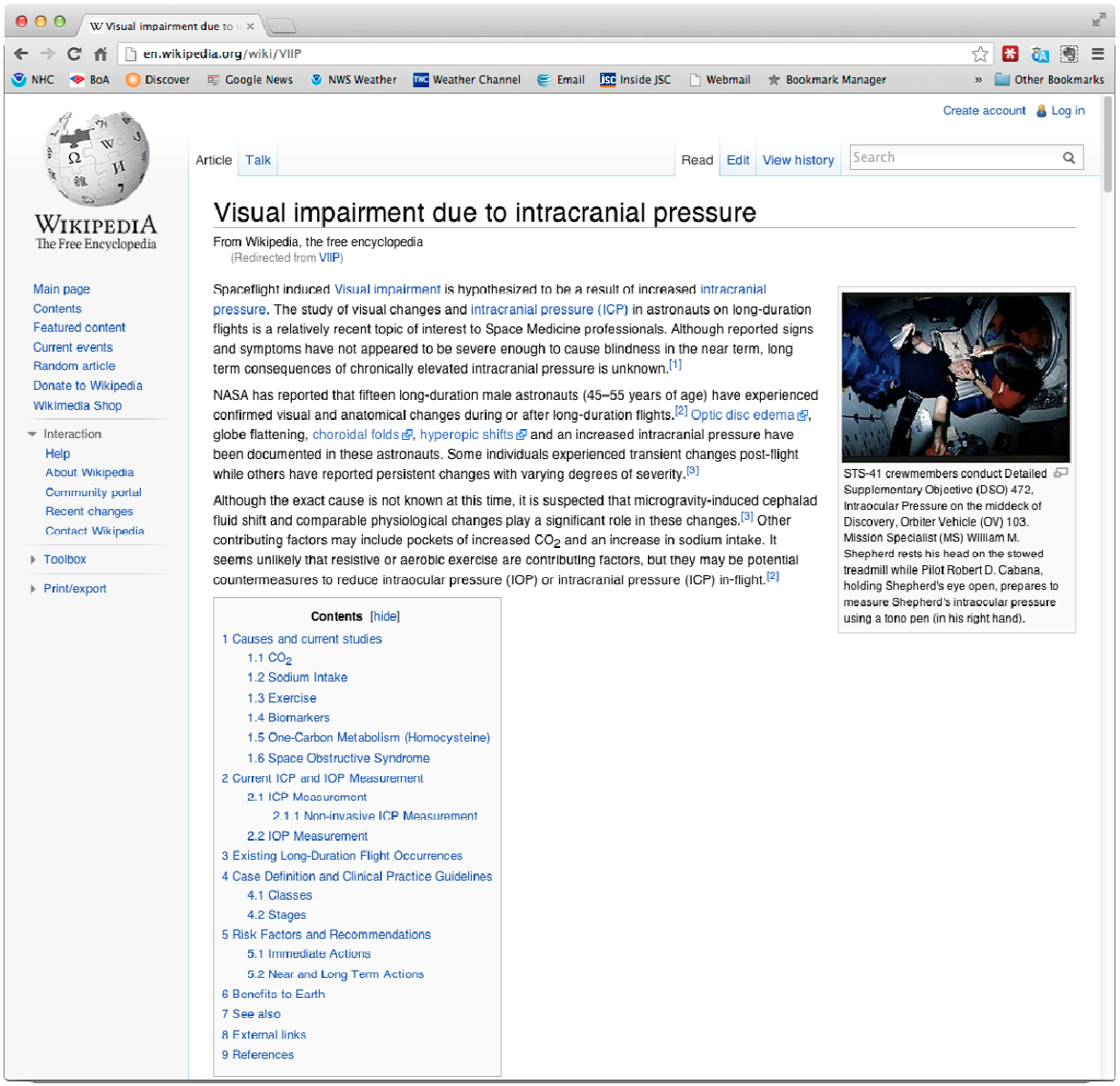




The HRP Portal

http://en.wikipedia.org/wiki/Portal:Human_Health_and_Performance_in_Space

A Wikipedia entry



W Visual impairment due to

en.wikipedia.org/wiki/VIIP

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Visual impairment due to intracranial pressure

From Wikipedia, the free encyclopedia
(Redirected from VIIP)

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Spaceflight induced Visual impairment is hypothesized to be a result of increased intracranial pressure. The study of visual changes and intracranial pressure (ICP) in astronauts on long-duration flights is a relatively recent topic of interest to Space Medicine professionals. Although reported signs and symptoms have not appeared to be severe enough to cause blindness in the near term, long term consequences of chronically elevated intracranial pressure is unknown.[1]

NASA has reported that fifteen long-duration male astronauts (45–55 years of age) have experienced confirmed visual and anatomical changes during or after long-duration flights.[2] Optic disc edema, globe flattening, choroidal folds, hyperopic shifts and an increased intracranial pressure have been documented in these astronauts. Some individuals experienced transient changes post-flight while others have reported persistent changes with varying degrees of severity.[3]

Although the exact cause is not known at this time, it is suspected that microgravity-induced cephalad fluid shift and comparable physiological changes play a significant role in these changes.[3] Other contributing factors may include pockets of increased CO_2 and an increase in sodium intake. It seems unlikely that resistive or aerobic exercise are contributing factors, but they may be potential countermeasures to reduce intraocular pressure (IOP) or intracranial pressure (ICP) in-flight.[2]

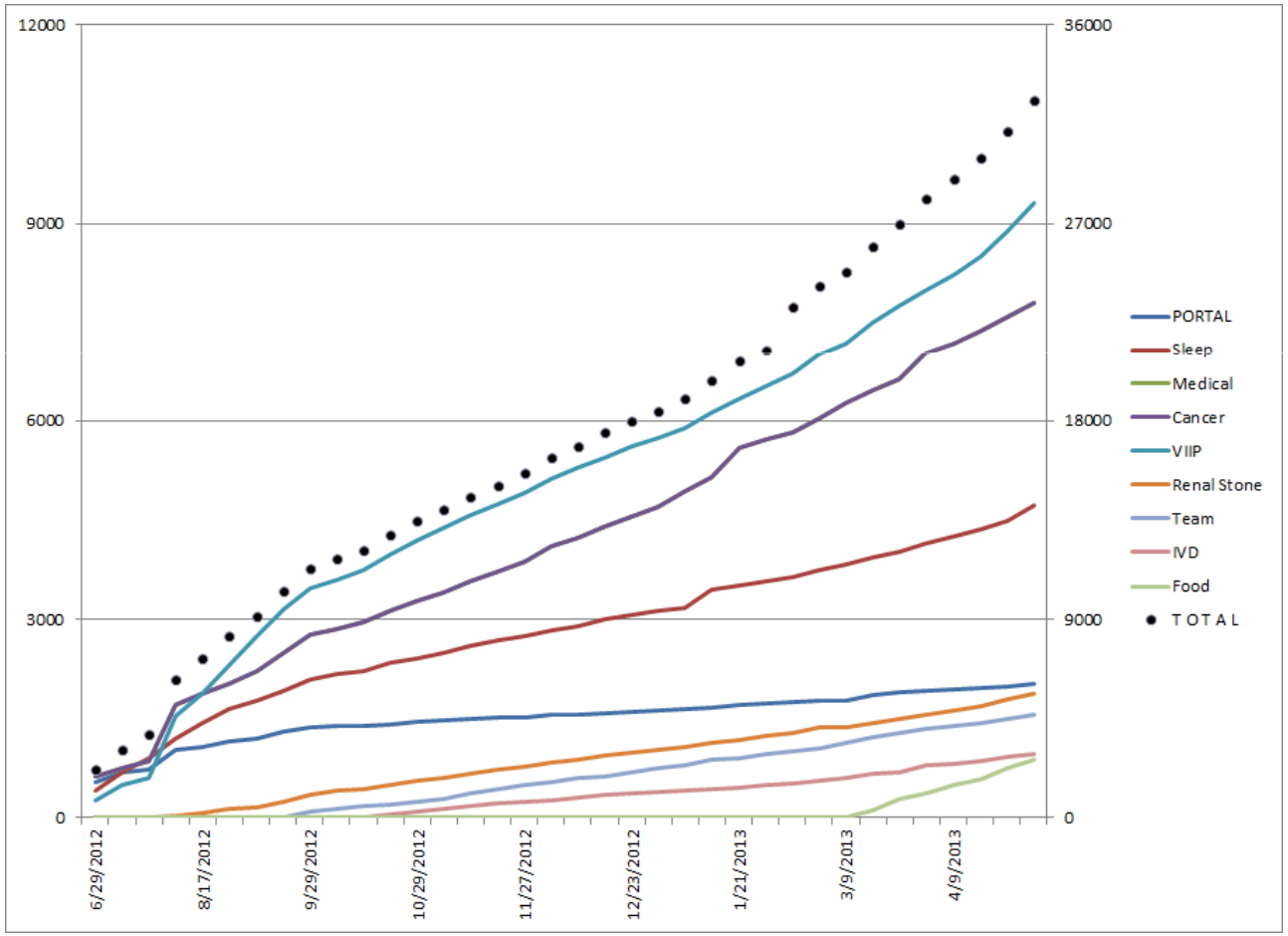
STS-41 crewmembers conduct Detailed Supplementary Objective (DSO) 472, Intraocular Pressure on the middeck of Discovery, Orbiter Vehicle (OV) 103. Mission Specialist (MS) William M. Shepherd rests his head on the stowed treadmill while Pilot Robert D. Cabana, holding Shepherd's eye open, prepares to measure Shepherd's intraocular pressure using a tono pen (in his right hand).

Contents [hide]

1 Causes and current studies
1.1 CO_2
1.2 Sodium Intake
1.3 Exercise
1.4 Biomarkers
1.5 One-Carbon Metabolism (Homocysteine)
1.6 Space Obstructive Syndrome
2 Current ICP and IOP Measurement
2.1 ICP Measurement
2.1.1 Non-invasive ICP Measurement
2.2 IOP Measurement
3 Existing Long-Duration Flight Occurrences
4 Case Definition and Clinical Practice Guidelines
4.1 Classes
4.2 Stages
5 Risk Factors and Recommendations
5.1 Immediate Actions
5.2 Near and Long Term Actions
6 Benefits to Earth
7 See also
8 External links
9 References

Strengths of the Wikipedia approach

- Extremely accessible
  - Reading
  - Contributing
- Many “hits”



Weaknesses of the Wikipedia approach

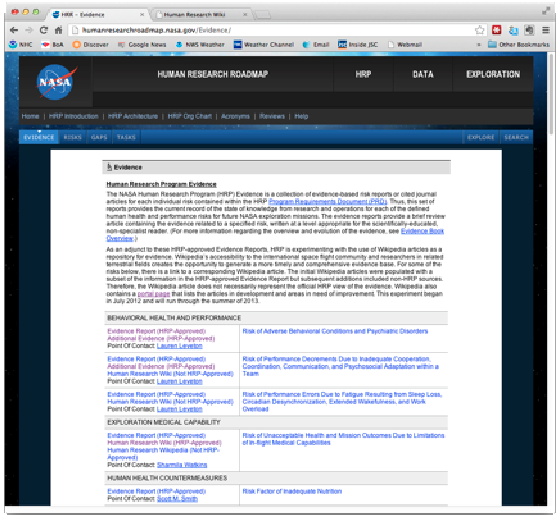
- Wikipedia rules for content
  - Cannot copy Evidence Reports
  - Must summarize Evidence Reports
    - The result article is a summary of a review
- Few contributions
  - Net loss of content
  - Workload to maintain thriving articles is unknown

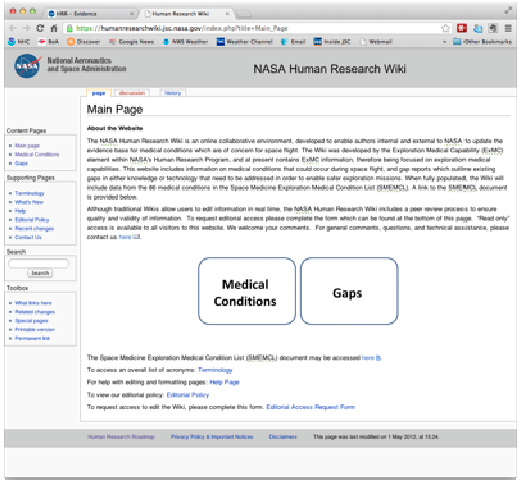
Type of Contribution	Number of Contributions
Citation	15 (placeholder)
Sentence added or modified	4 (placeholder
Paragraph	2 (placeholder)

The Third Generation Evidence Base

- Wiki based
- Editorially controlled
  - Editorial Board for each Evidence Report
- Initial content = HRP-approved Evidence Reports
  - Verbatim
- Contributions
  - Default: pre-screened by editorial board
  - Pre-approved contributors: screen post facto by editorial board
- Coming Fall 2013

humanresearchroadmap.nasa.gov/Evidence





Conclusion

- NASA's Human Research Program seeks to understand and mitigate risks to crew health and performance in exploration missions
- HRP's evidence base consists of an Evidence Report for each HRP risk
- Three generations of Evidence Reports
  1) Review articles
     + Good content
     - Limited authorship, infrequent updates
  2) Wikipedia articles
     + Viewed often, very open to contributions
     - Summary of reviews, very few contributions
  3) HRP-controlled wiki articles
     + Incremental additions to review articles with editorial control
     - ?

humanresearchroadmap.nasa.gov/Evidence